Université d'Ottawa
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ELG4125 Lab Project Task 1

Sizing the Electrical Load of a Large Building
Submission: October 3, 2022
Group 17

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MNT building design

lab task 1: Sizing the Electrical Load

1

Size the floor based on its utility power density and specal loard power consumption

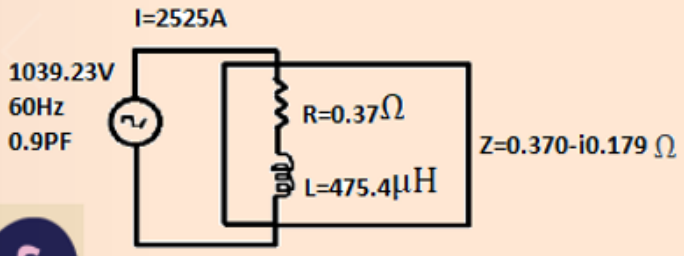
2

Sum the total load of 7 floors include special loads(elevator and emergency panel)
Demand load 2362kW

3

2 Main Transfomers for MNT Hall(20kV 3MW)
18 sub trasnformers for the floor and special load(480V 150kW)

6



5

Turn the entire building into an inductive load in a circuit diagram, calculate the V, I, and Z

4

Size cables by using the "current-conductor size" table, design the main layout

Building Floor Plan Layout

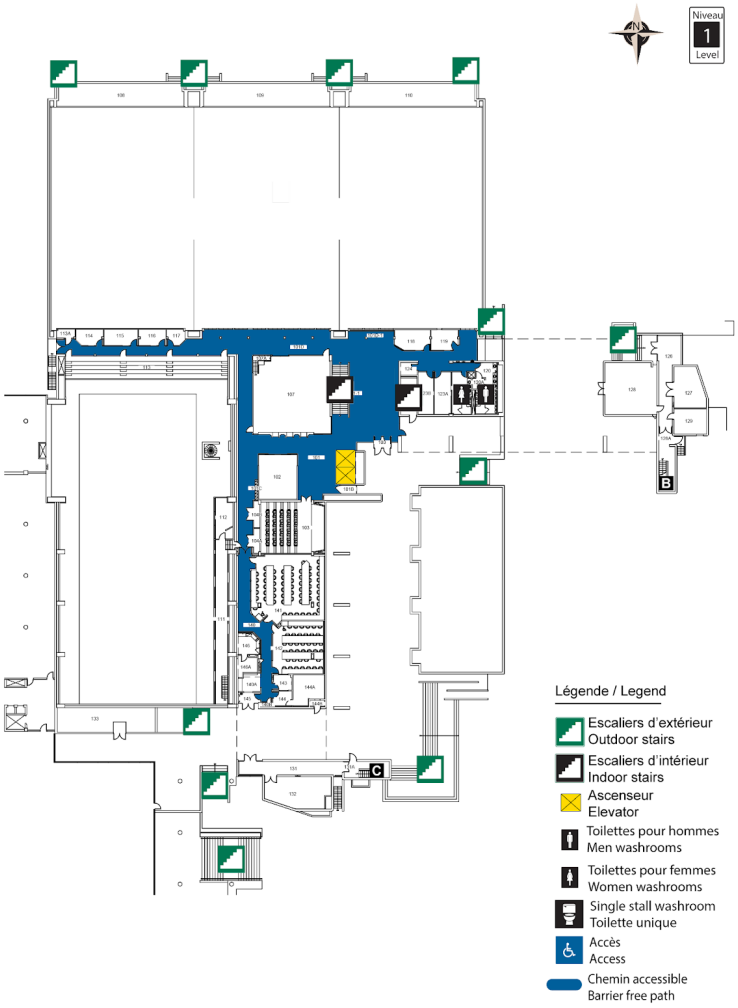


Figure 1: Montpetit Level 1 Floor Plan

Sizing the Building

Table 14
Watts per square metre and demand factors for services and feeders for various types of occupancy
(See Rules 8-002 and 8-210.)

Type of occupancy	Watts per square metre	Demand factor, %	
		Insulated service conductors or cables	Feeders
Store, restaurant	30	100	100
Office			
First 930 m²	50	90	100
All in excess of 930 m²	50	70	90
Industrial and commercial	25	100	100
Church	10	100	100
Garage	10	100	100
Storage warehouse	5	70	90
Theatre	30	75	95
Armouries and auditoriums	10	80	100
Banks	50	100	100
Barbershops and beauty parlours	30	90	100
Clubs	20	80	100
Courthouses	20	100	100
Lodges	15	80	100

Figure 2: 2021 Canadian Standards Association (Page 473 on CEC-2021)

Normal Load Summary

	Area(m^2)	Power Density(w/m^2)	930m^2 load(kW)	Demand Factor	Rest of the Load	Demand Factor	Total Demand Load
Gross Floor area	18455						
00	2636.43	50	46.5	90%	17.06	100%	63.56
0	2636.43	50	46.5	90%	17.06	100%	63.56
1	2636.43	50	46.5	90%	85.32	70%	101.57

2	2636.43	50	46.5	90%	85.32	70%	101.57
3	2636.43	50	46.5	90%	85.32	70%	101.57
4	2636.43	50	46.5	90%	85.32	70%	101.57
5	2636.43	50	46.5	90%	85.32	70%	101.57

Special Load Summary

	Load(kW)	Demand Load(kW)	Total Building Load(kW)
Heating and cooling HVAC system	150	150	1050
Fire protection	10	10	70
Lab equipment	25	25	175
Elevator(total)	12	12	12
Computers	30	30	210
Lighting	30	30	210

Overall Load Summary

	Load(kW)	Demand Load(kW)
Basic load	786.22	634.97
Special load	1727	1727
Total	2513.22	2361.97

Transformer Selection

Main Transformer	
Phase	3
Rated Capacity	3MW
Primary Voltage	20kV
Secondary Voltage	400V

Frequency	60Hz
Amount Required	2

Sub Transformer	
Phase	3
Rated Capacity	150kW
Primary Voltage	480V
Secondary Voltage	240V
Frequency	60Hz
Amount Required	18

Single Line Diagram of Electrical System

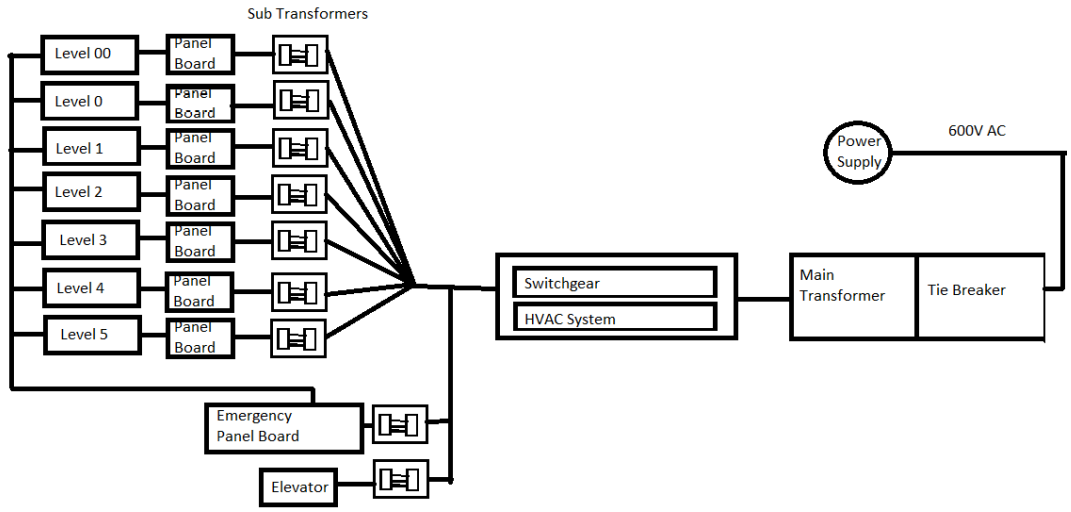


Figure 3: Single line diagram for the building electrical system

Current-Conductor Size

Cross Section (mm^2)	Approximate Overall Diameter (mm)	Current Rating	
		Single Phase (Amps)	Three Phase (Amps)
1.5	2.9	17.5	15.5
2.5	3.53	24	21
4.0	4.4	32	28
6.0	4.68	41	36
10	5.98	57	50
16	6.95	76	68
25	8.7	101	89
35	10.08	125	110
50	11.8	151	134
70	13.5	192	171
95	15.7	232	207
120	17.4	296	239
150	19.3	300	262
185	21.5	341	296
240	24.6	400	346
300	27.9	458	394
400	30.8	546	467
500	33.8	626	533
630	37.6	720	611

Figure 4: Cable size reference table

$$V_L = 600$$

$$V_{rms} = \frac{3 * 600}{\sqrt{3}} = 1039.23V$$

$$P = 2.362MW$$

$$PF = 0.9$$

$$\theta = arccosPF = 25.8°$$

$$I_{rms} = \frac{2.362 * 10^6}{1039.23 * 0.9} = 2525A$$

$$Z = \frac{V_{rms}}{I_{rms}\angle 25.8°} = 0.3705497 - 0.1791308i\Omega$$

$$R = 0.37\Omega$$

$$Q = 1039.23 * 2525 * \sin 25.8 = 1.006156MVAR$$

$$L = \frac{XL}{2\pi f} = \frac{0.1791308}{2\pi * 60} = 475.4\ \mu H$$

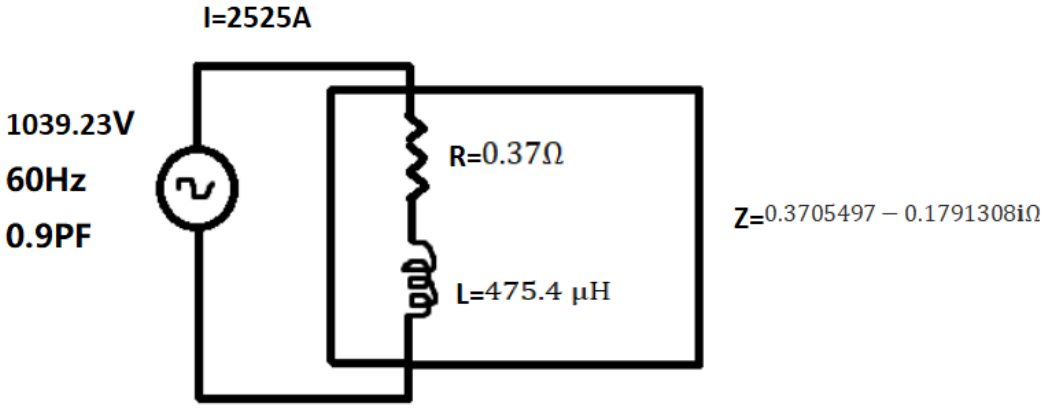


Figure 5: Circuit Diagram of the building